DATA LITERACY

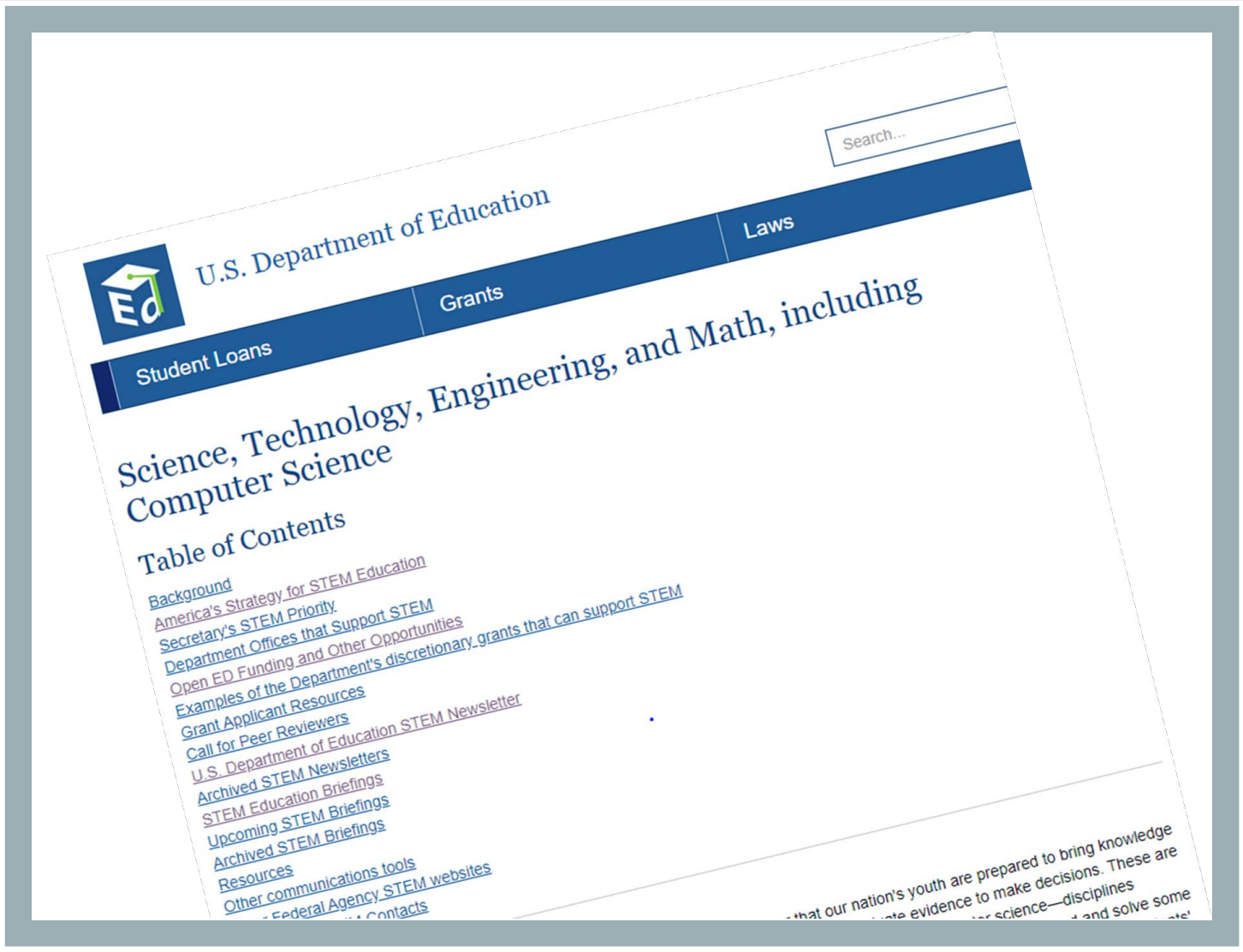
October 15, 2021, 2:00 – 3:30 PM ET

DISCLAIMER

Any content or opinions expressed in this webinar are not that of the U.S. Department of Education nor an endorsement of any persons, products, programs, or policies mentioned herein.

U.S. DEPARTMENT OF EDUCATION STEM RESOURCES

ED.GOV/STEM



CONTEXT: DATA ON DATA SCIENCE

- Top Jobs Demanded in 2020 Globally (World Economic Forum)
- Top 10 Jobs in 2017, 2018, and 2019 (LinkedIn)
- Top 5 Skillsets Demanded since 2014 (LinkedIn)

We know these skillsets are important for personal finance, health, and civic engagement.

NATIONAL SPREADSHEET DAY

OCT 17

DEPUTY SECRETARY CINDY MARTEN

U.S. Department of Education

STEVEN LEVITT

Freakonomics Co-Author

William B. Ogden
Distinguished Service
Professor of Economics,
University of Chicago

Freakonomics Podcast #391

TRENA WILKERSON

President, National Council of Teachers for Mathematics

Data Literacy

Data Science Mathematics, Statistics, and the Disciplines

Trena L. Wilkerson, NCTM President
Professor of Mathematics Education
Baylor University
www.nctm.org
twilkerson@nctm.org

NCTM | NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Key Considerations

- Understand and critique our world
- Expand opportunities
- Critical thinking skills are essential
- Vital for both STEM and non-STEM fields
- Imperative for all students
- Make connections across and within disciplines/fields- Understanding Context

Fostering data literacy includes

fostering mathematics, statistics, quantitative, media, and discipline specific literacy to equip students with the knowledge and resources needed to make sound, informed decisions and to solve problems arising in their personal and professional lives as members of society.

NCTM's Catalyzing Change Series for Early Childhood and Elementary Mathematics (2020), Middle School Mathematics (2020) and High School Mathematics (2018)

NCTM | NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

Partners & Stakeholders

- Families/Caregivers
- Communities
- Teacher Educators
- Businesses
- Schools-teachers, administrators, school boards, Pk-12+
- Post-Secondary Education
- Curriculum & Assessment Writers/Developers

Data Literacy

- Equity Stance/Lens
- Build/foster/support positive identity
- Inclusive across Pk-12
  - Meaningful, thoughtful approach
- Rethink/Reimagine statistics education
- Interdisciplinary approach
- How to support ALL teachers in this work

An imperative!

Data literacy

The development of statistical thinking is an imperative today. Every individual must be able to synthesize data to support decision making, make sense of our world, and prepare for the future.

November 2020 President's Message (Wilkerson)

An Imperative for Our Future

"Making a difference will require collaboration, communication, and work across diverse groups and communities, but engaging in these conversations is our collective responsibility to the students of today and tomorrow, as well as to our democratic society at large"

(Catalyzing Change in High School Mathematics: Initiating Critical Conversations, NCTM 2018, p. 93)

JO BOALER

Nomellini & Olivier
Professor of Education,
Stanford University

Director, youcubed

Introduction – Youcubed Data Science

Jo Boaler,

The Nominelli-Olivier Professor of Mathematics Education

@joboaler

Stanford University

youcubed

K-12 Data Science

youcubed
at Stanford University

- Our goal is to share free resources for teachers & students showing the beauty and creativity in open mathematics & data science
  - Over 53 million visits to website in last 5 years
  - Hundreds of free tasks & lessons K-16
  - Used in 2/3 of US Schools
  - 145,000 newsletter subscribers
  - TEDx talks – over 1.5 million views
  - Newsletters opened in over 160 countries

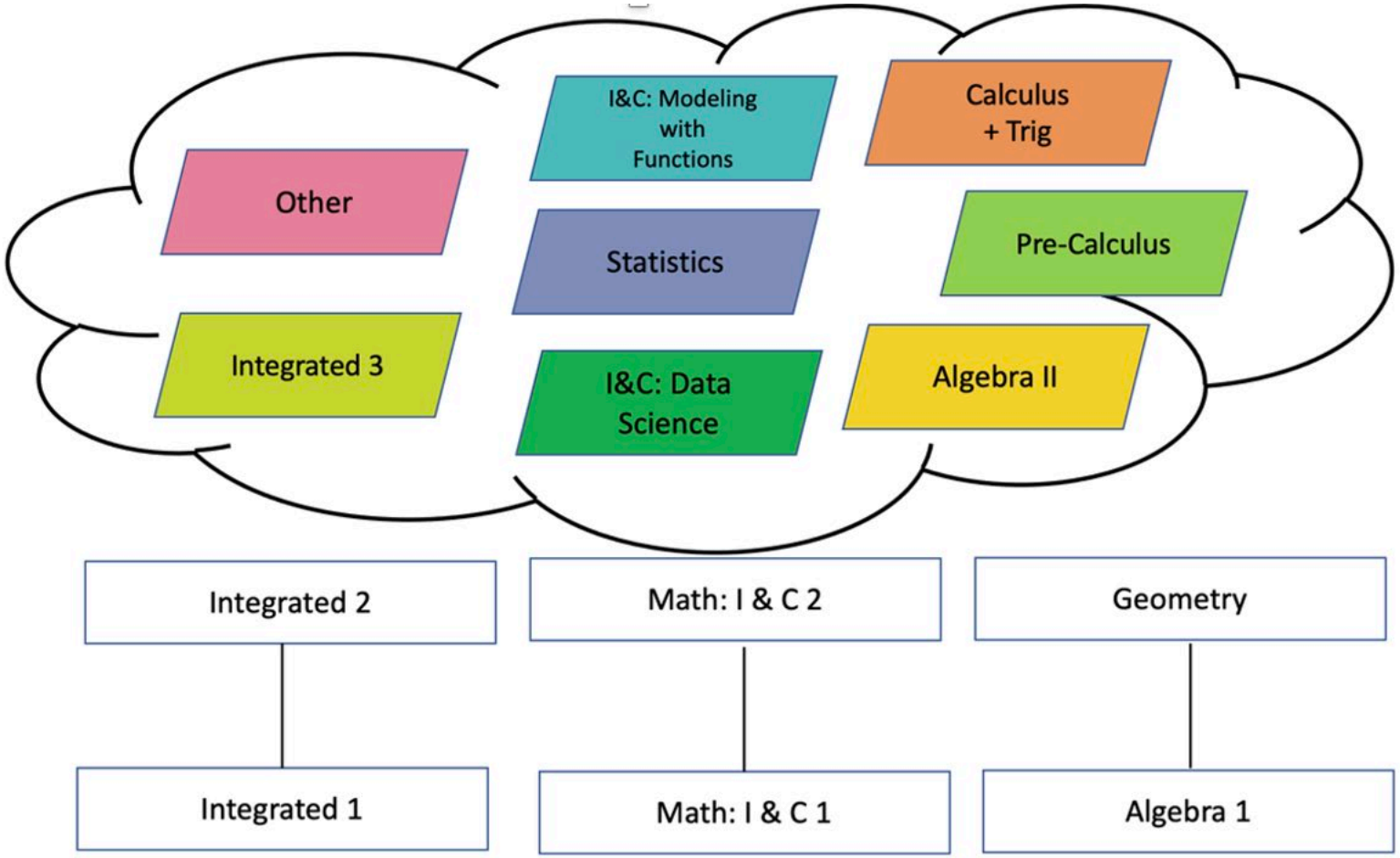
Data Science K-12
is highlighted

Data Science can be an
equitable pathway

California Mathematics Framework

youcubed
at Stanford University

High School Pathways – in California and beyond



California Mathematics Framework, 2022

Data Science | K-10

BIG IDEAS

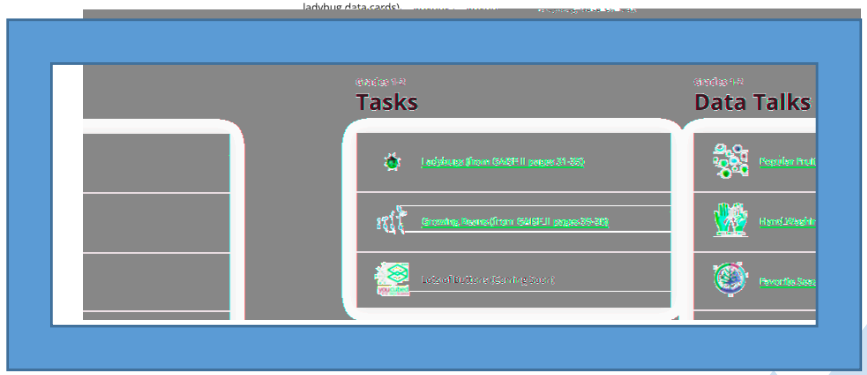
A Selection of Big Ideas from Data Science – from GAISE II (2021).

Formulate statistical investigative questions	Collect/consider data	Analyze data	Interpret and communicate
• Formulate statistical investigative questions	• Students learn what counts as data (eg visuals, sounds, numbers, categories) and understand that people collect data to answer questions • Students develop	• Students develop ways to represent and interrogate data to notice, describe and analyze patterns • Students recognize variability and use technology to develop models that incorporate	• Students decide key results to include in a data report that answers the statistical investigative question • Students communicate their results through, for example, a data visual, a
• Students generate ideas and ask questions – creating and refining statistical investigation questions			

Co-author:
Rob Gould

Integrating data science into the content being taught

Example of “Big Ideas” for Grades 1-2



Over 10,000 visits since Monday!!

Online Class to excite teachers about data science

Taken by over 20,000 teachers

What is Data Science and why it is important?

Teaching Examples – Classroom Video

CODAP Explorations

Teaching Content – Probability & Statistics

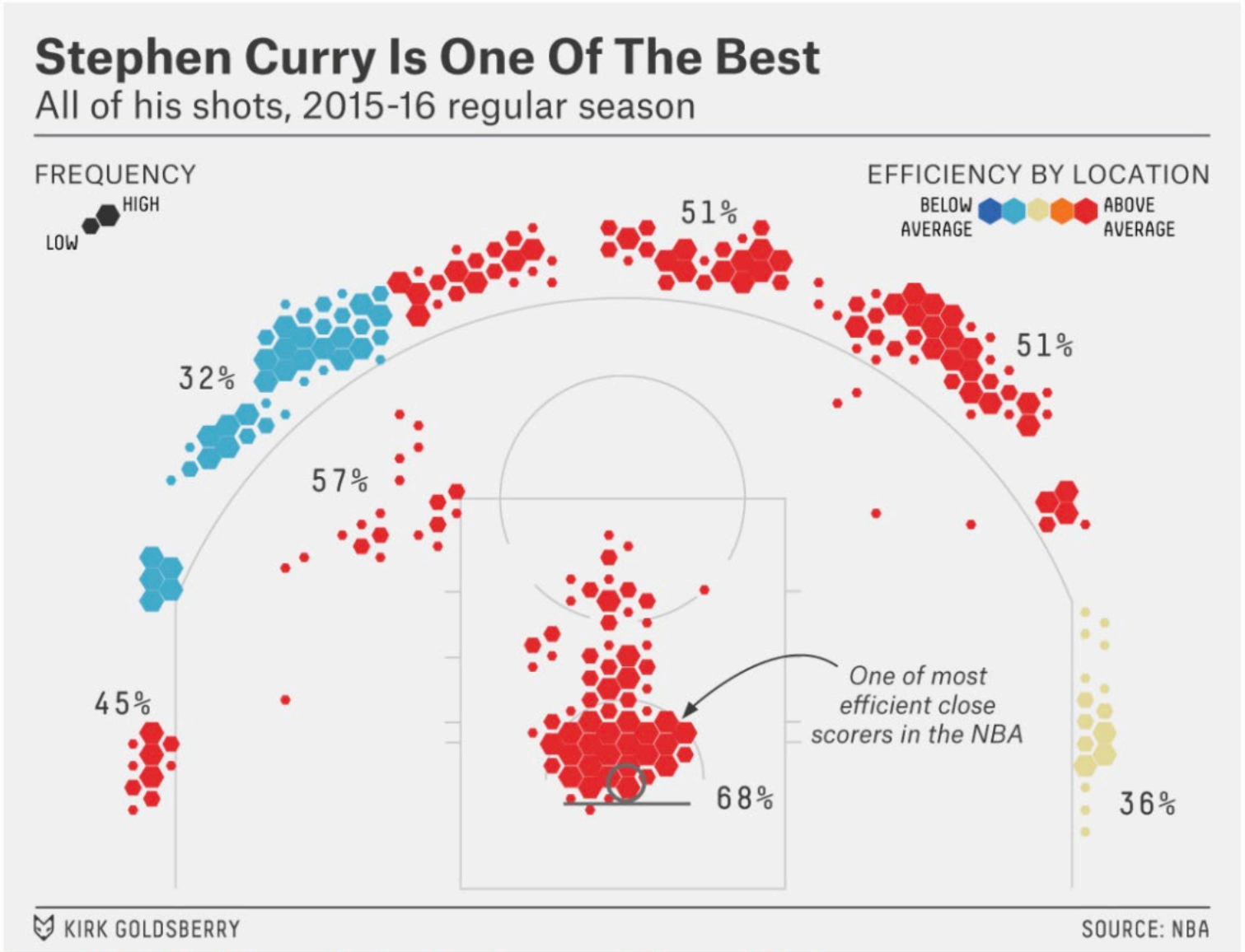
Student Videos for Use in Classrooms

Part of the State of Utah Data Science Credential

Facebook group: 2.7K members

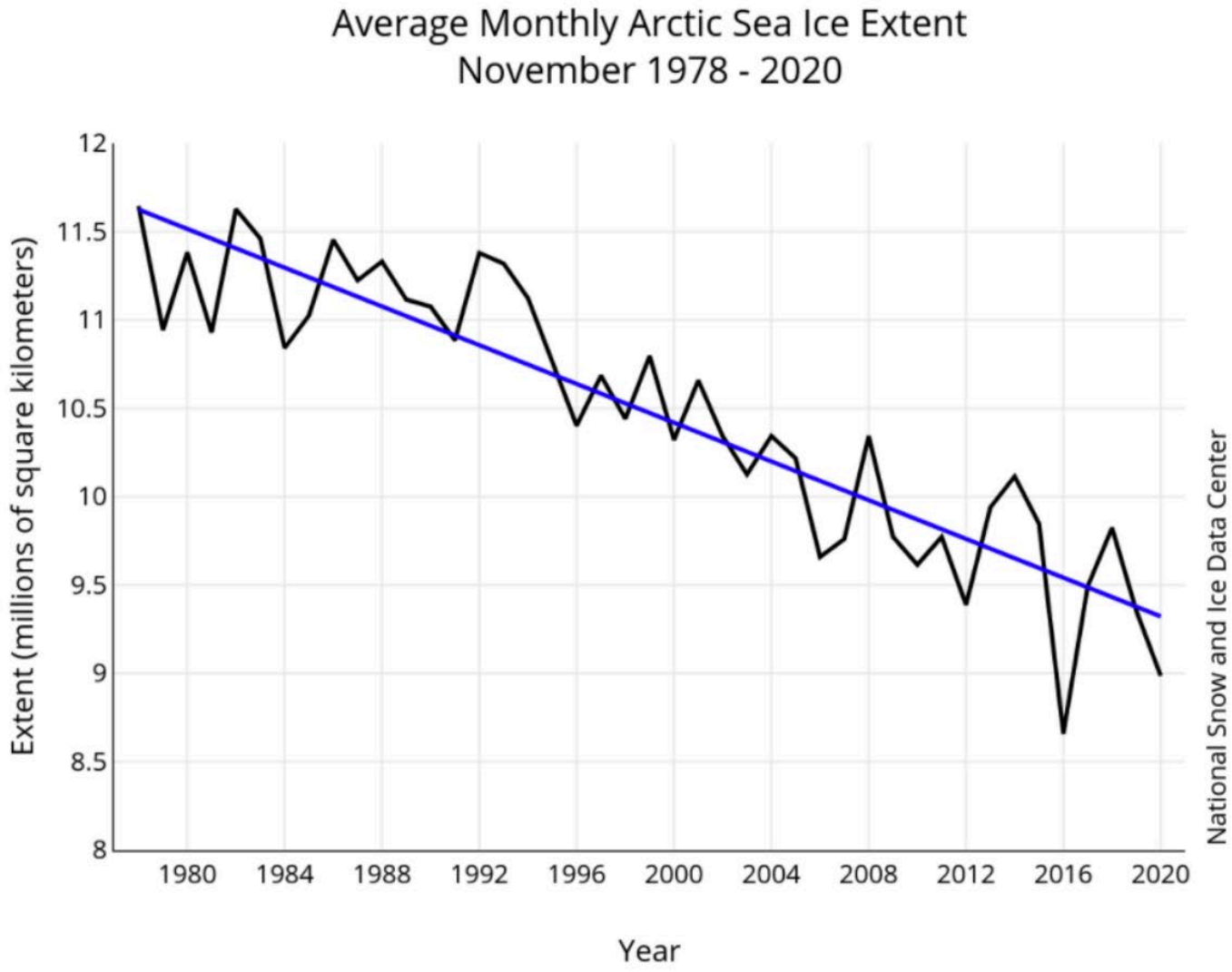
K-12 Data Talks

• What do you notice? • What do you wonder? • What is going on in this data visualization?



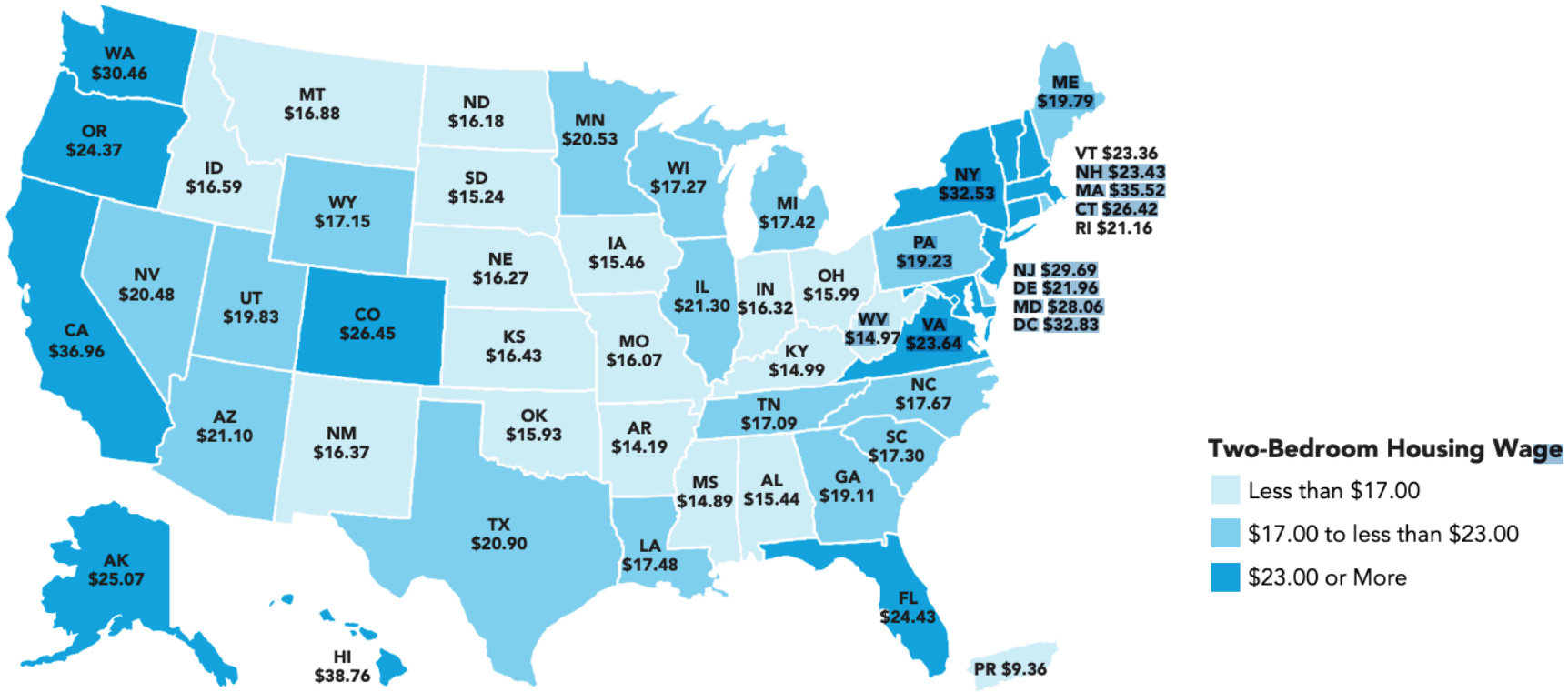
https://fivethirtyeight.com/features/stephen-curry-is-the-revolution/

- What do you notice?
- What do you wonder?
- What is going on in this data visualization?



Pola Bear declines

2020 TWO-BEDROOM RENTAL HOUSING WAGES

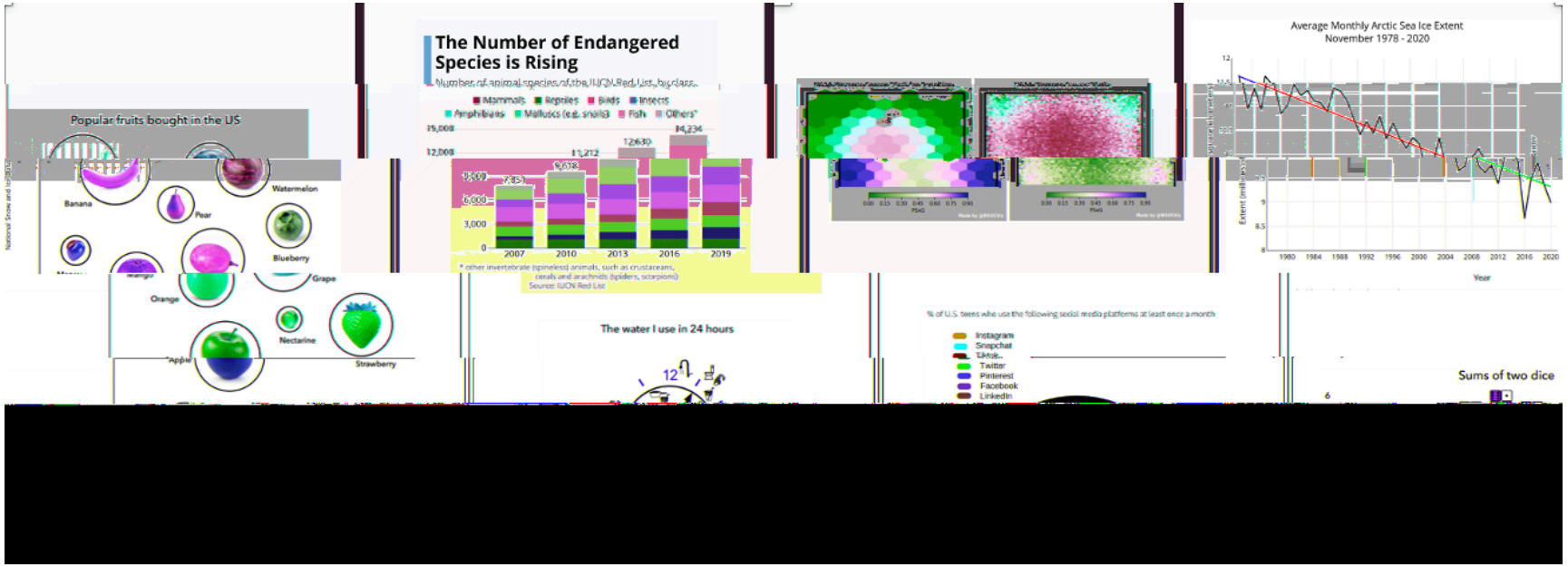


A **living wage** is a wage that is high enough to maintain a normal standard of living.

A **minimum wage** is the lowest an employer can pay an employee for their work.

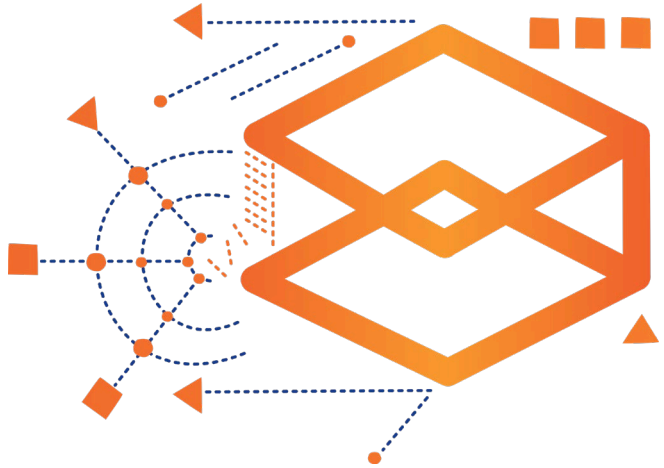
A **housing wage** is an estimate of the hourly wage a full-time worker must earn to afford a modest rental home without spending more than 30% of their income on housing costs.

Youcubed – data science – data talks



Over 100,000 Downloads

Youcubed Data Science Resources: Grade 6-10 Lessons



Over 30,000 downloads

youcubed K-12 Data Science

High School Course:
Explorations in Data Science:
Youcubed Adaptable Curriculum

Partnered with
Google & tableau

Youcubed Adaptable Curriculum– in partnership with Google

- Free with low Barrier for Entry
- Widely Accessible Tools
- Low-Floor, High Ceiling – Project based
- Live and Current Datasets
- Use of Local & Customizable Data
- Broad Flexibility for Individual Settings

Academic Advisors and Industry Advisors

Talithia Williams
Dept of Mathematics
Harvey Mudd

Rachel Levy
Mathematician

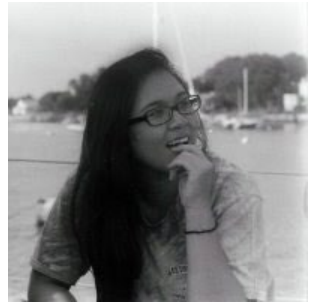
Elena Grewal
Previously Head of
Data Science
Airbnb

Evan Shieh
Data Scientist
Amazon

Rob Gould
Dept of Statistics
UCLA

Steve Levitt
Economist
University of Chicago

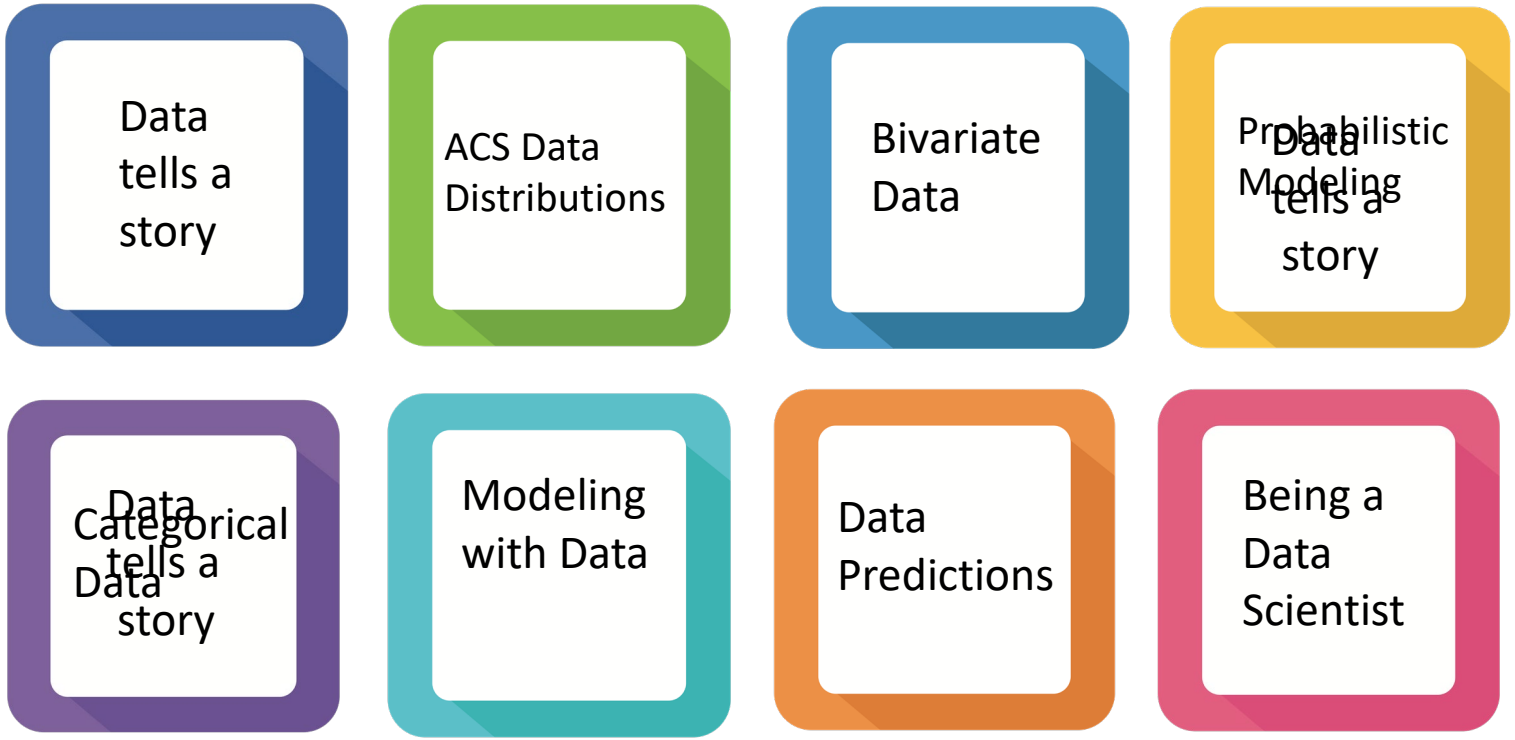
Jeff Feng, Airbnb
Head of Machine
Learning



Ellen Huynh, Airbnb
Senior Program
Manager

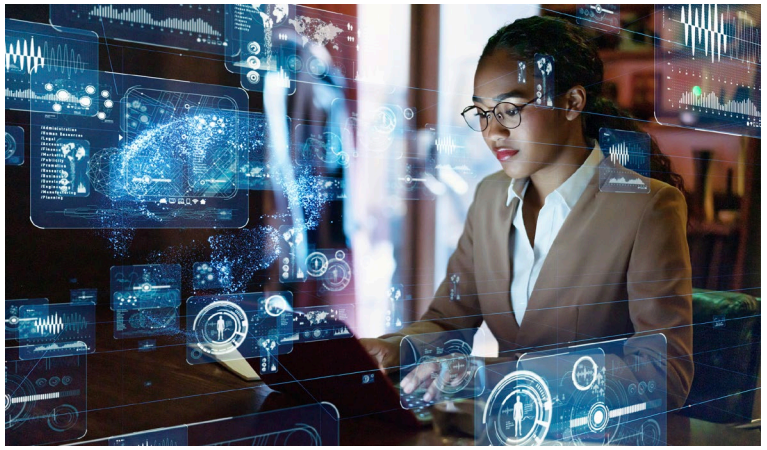
Project Based

Youcubed: Explorations in Data Science: 8 Units



A Project Based One Year Course

Encouraging Student Agency



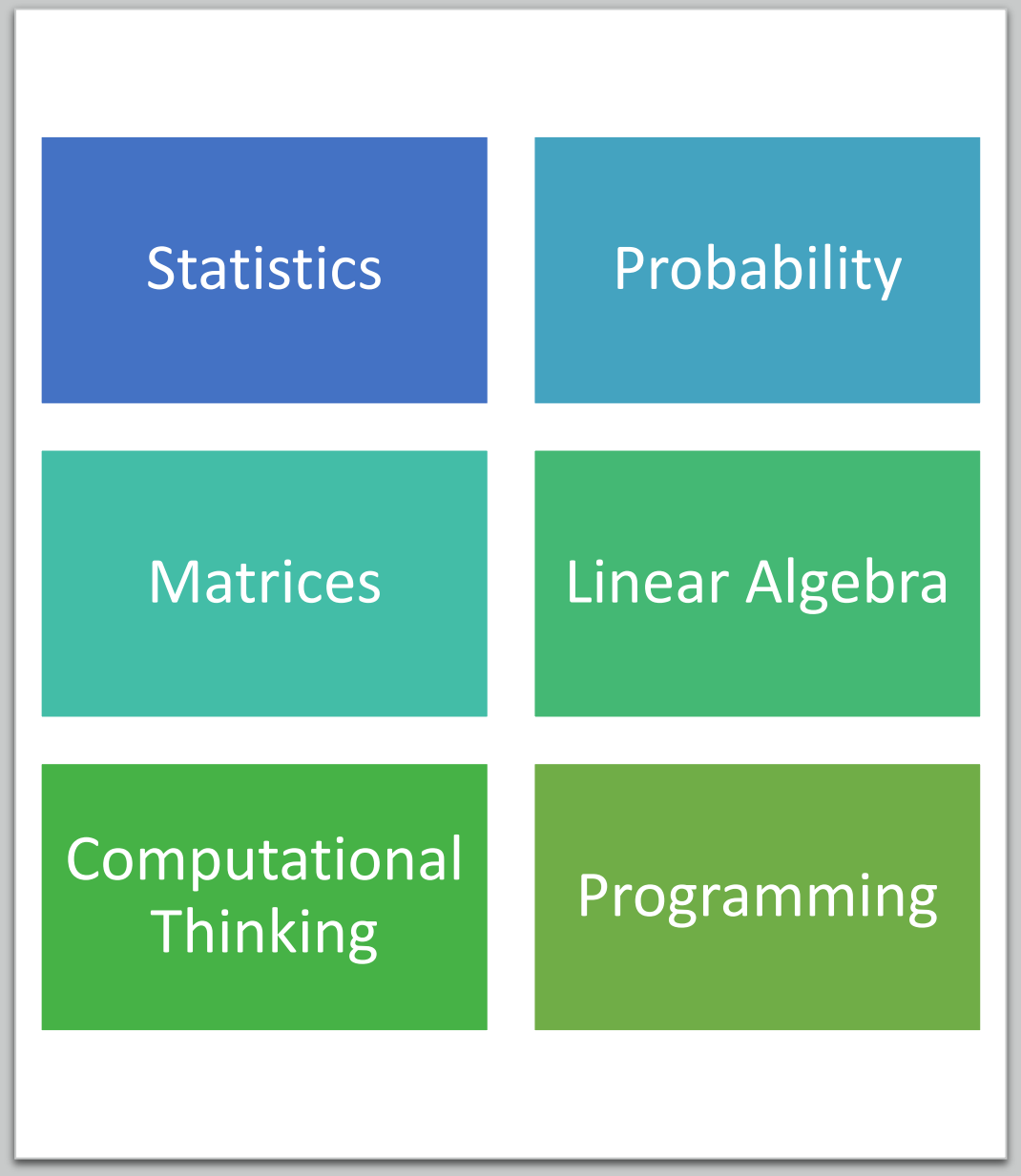
Students ask their own questions & investigate data sets from their own communities

What will students learn?

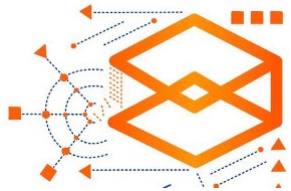
CODAP

python™

The mathematics of high school data science



Who is taking our data science course?



- 1500 accounts made, 100,000 page views
- This year - 575 teachers in 500 different schools/districts

  (220 have been to our PD)
- Over 30,000 students

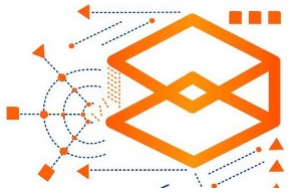
  - 46% girls/non-binary
  - 40% students of color
  - 58% not mathematically accelerated

High School Professional Development Workshops @youcubed.
In person and online

Enjoyment & Engagement

Data Science

- This is the most interesting course I have taken. An profound analyzation of data feels like deciphering a crime scene for clues. .
- It's fun. It’s like you're a research expert.
- Everyone is involved in group projects no matter what, which is what makes it a great course.



In comparison to other classes

- It’s a well thought class that does not overload you with work and tests.
- Even the grading scale is fair & I won’t worry if I need to fix an assignment
- This course definitely surprised me after being enrolled to it for a month now. I enjoy it a lot more than I thought. From how the grading works, to the curriculum, or the communication this class has. It’s such a great way of learning along with it also being a very enjoyable class.

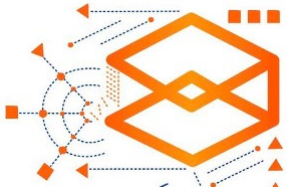
Challenge

Data Science

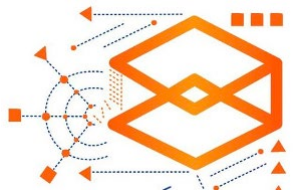
- This data science course is challenging but in a good way.
- I think it can be very challenging but working groups and the help of our teacher, it's more understandable
- I would describe it as challenging, fun, and creative because some tasks are challenging and yet you get to be creative.

Other Maths Classes

- In normal integrate/pre-cal classes I'm always lost and behind.
- I think this course is interesting and funner to learn. I am enjoying it because there is more group discussion and more projects so you aren't just sitting in class bored and confused



Learning from Data Science



- Data science is something you will eventually need. I personally recommend it to anyone who’s thinking of it. It's the class of the future.
- I really like this class and I hope to see it being added to more high schools
- It's a class that helps with deep thinking on data that helps to understand how data is collected and useful. It brings the side of critical math thinking that I didn't know I had
- I realized many things about myself and other things I like ever since I’ve been in this class.

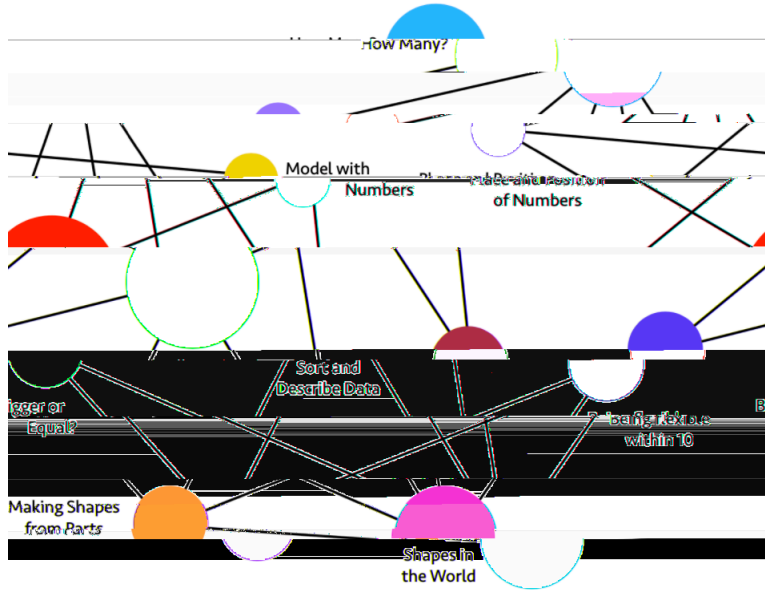
Initiative to Change University Admissions

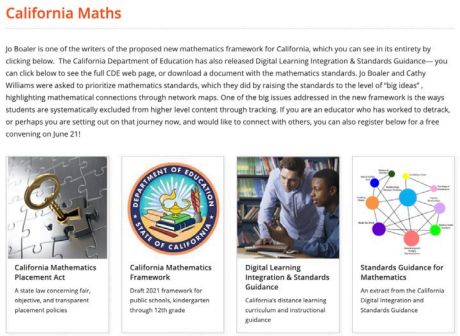
Stanford change…

Mathematics: four years of any rigorous mathematics incorporating a solid grounding in fundamental skills (algebra, geometry, trigonometry). We also welcome preparation in skills related to statistics, data science and calculus.

Data Science throughout K-12

- New Initiative from the State of California
- Big Ideas instead of standards
- Mathematics writing team: Jo Boaler & Cathy Williams





Youcubed – California Maths

SUYEN MACHADO

Co-Author, Introduction to Data Science

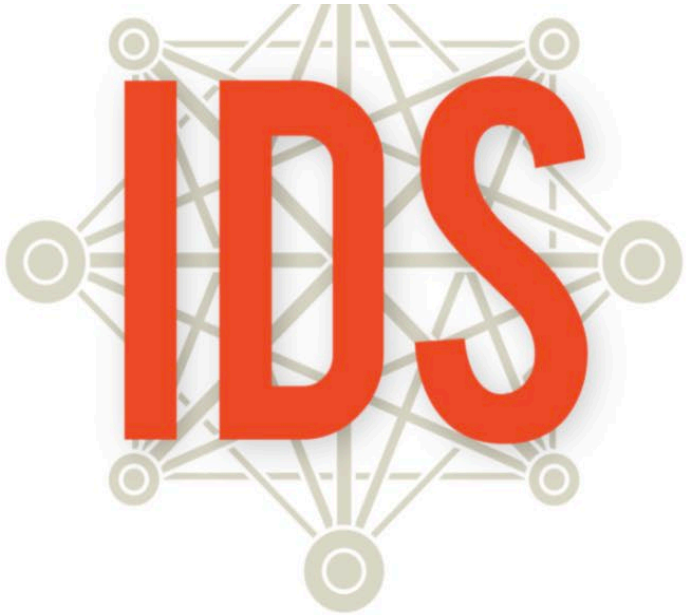
UCLA, Center X

Introduction to Data Science (IDS) for High School Students

Suyen Machado

Co-author & Director, Data Science Project

University of California, Los Angeles



Introduction to Data Science

DELTA
GROUP 2
NAME
HEIGHT
FOOTWEAR
CAMRIE 61" FF
DAKOTA 72" S
EMERSON 65" S
HAYDEN 68" FF
JESSIE 61" FF
KAMRYN 66" S
LANDON 69" 3.98 S
SAWYER 67" 2.96 3.9 T FF

Retrieved from: https://nasaeclips.arc.nasa.gov/teachertoolbox/the5e

The Data Science Test

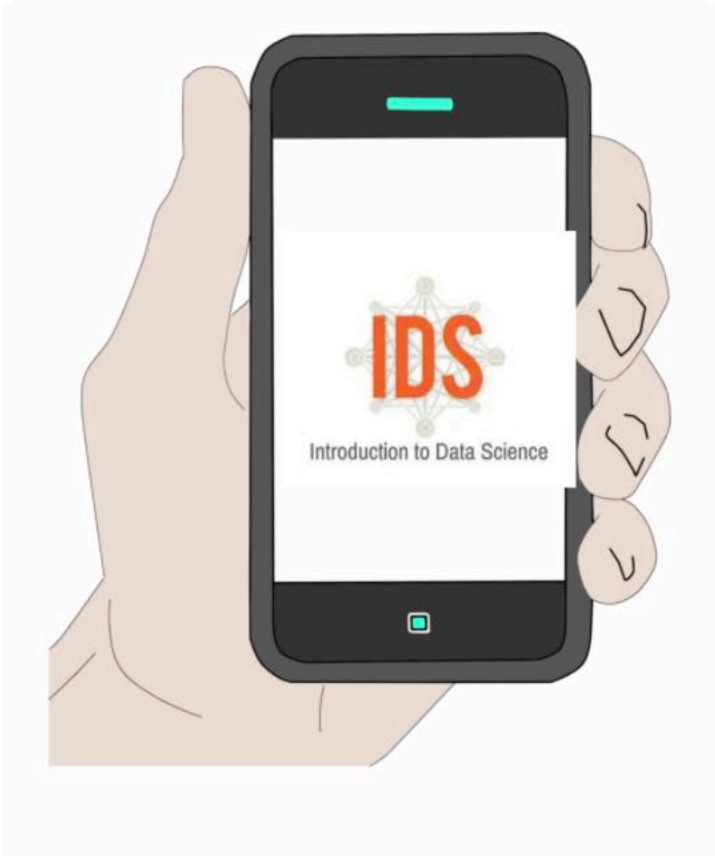
- Awash in Data
- Data Moves
- Data Properties

https://bestcase.wordpress.com

IDS Components

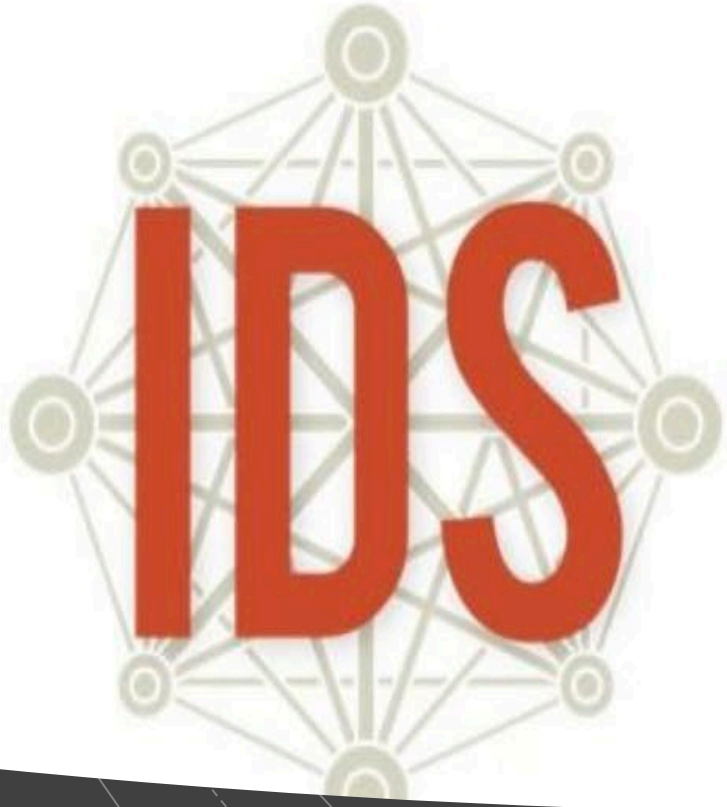
Introduction to Data Science

Robert Gould
Suyen Machado
Terri Anna Johnson
James Molyneux



Year-long Curriculum + Technology Suite + PD

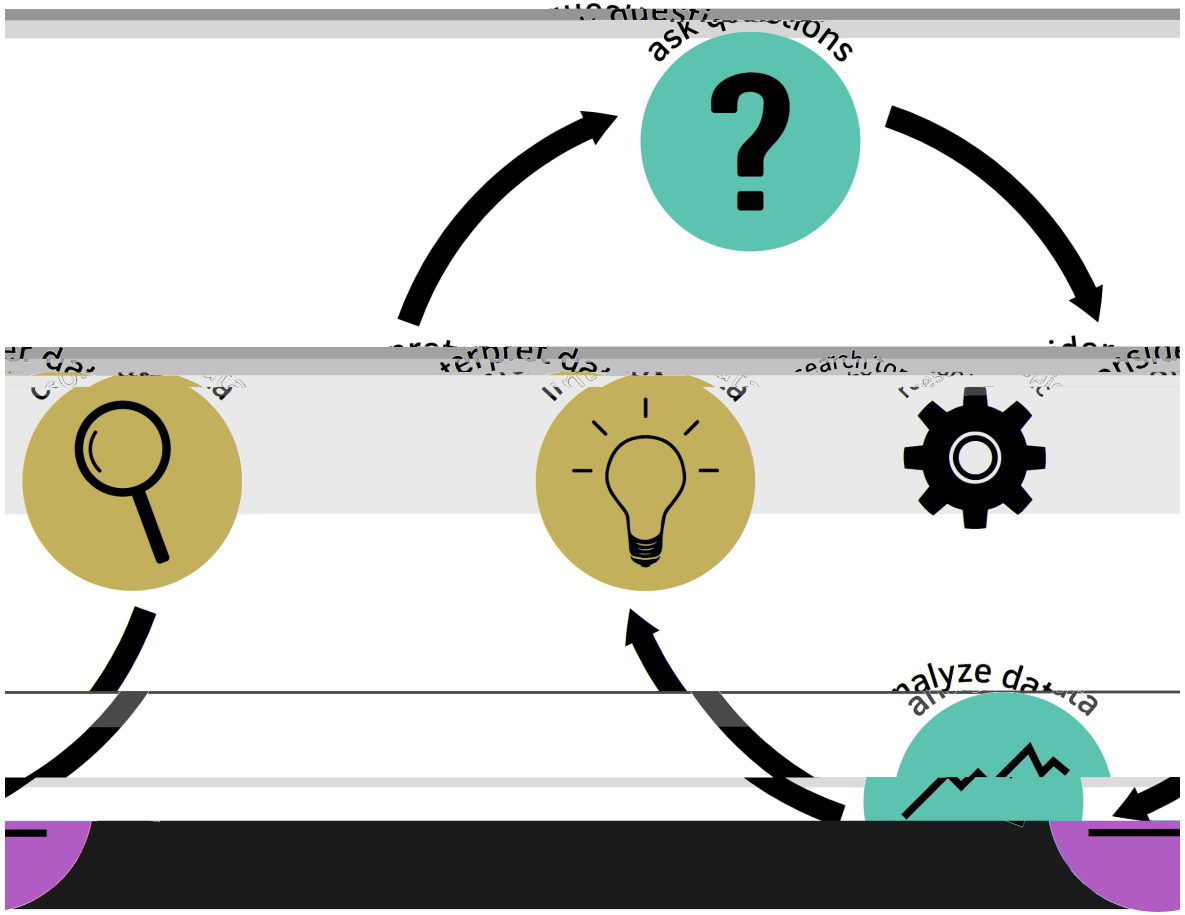
Introduction to Data Science



IDS Curriculum

Unit 1 - *Data and Visualizations*
Unit 2 - *Distributions, Probability, and Simulations*
Unit 3 - *Data Collection Methods: Traditional and Modern*
Unit 4 - *Predictions and Models*

The Data Cycle



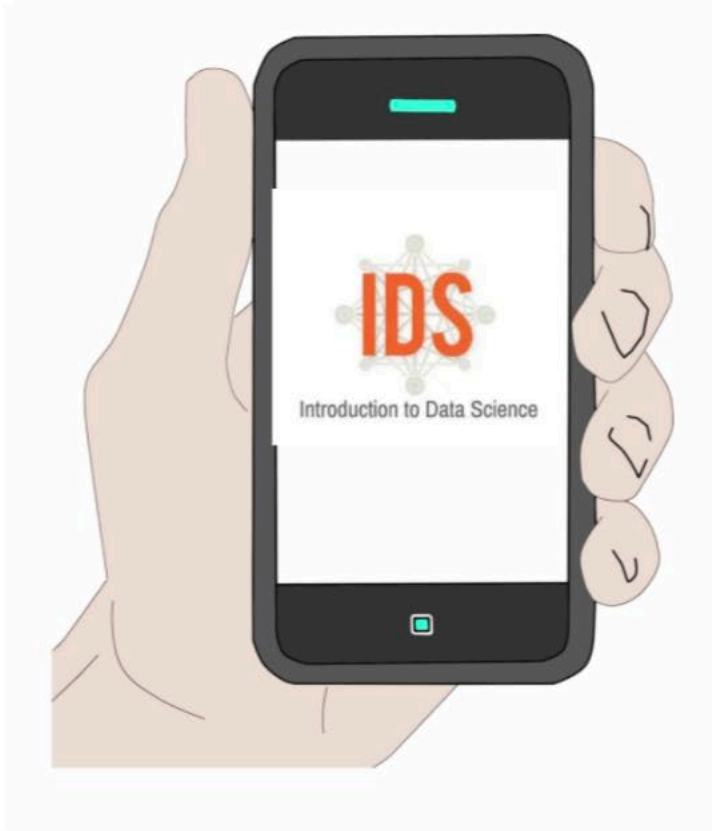
IDS

Introduction to Data Science

LESSONS LABS PROJECTS

IDS Technology

IDS Web Tools



R Studio®

Participatory Sensing

PARTICIPATORY SENSING

An approach to data collection and interpretation in which individuals, acting alone or in groups, use their personal mobile devices and web services to systematically explore interesting aspects of their worlds, ranging from health to culture.

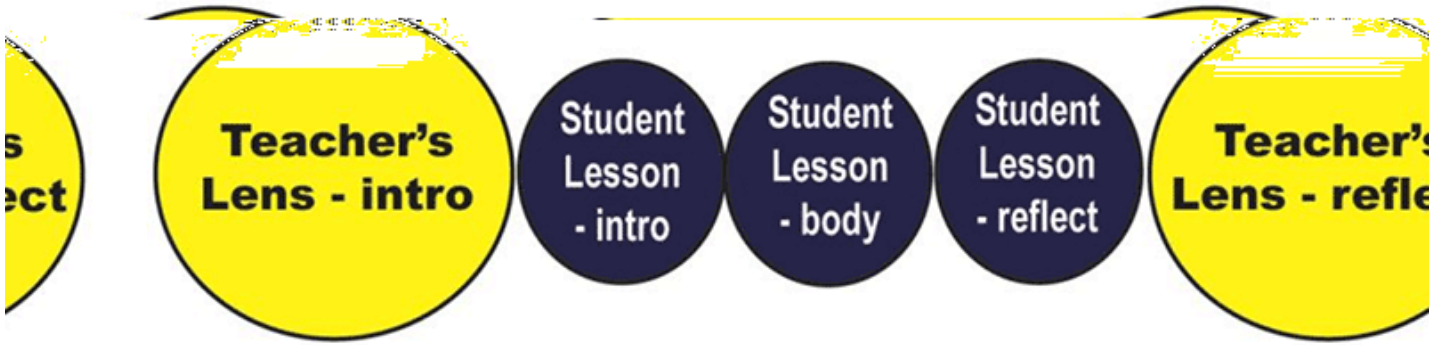
FOOD HABITS CAMPAIGN

STRESS CHILL CAMPAIGN

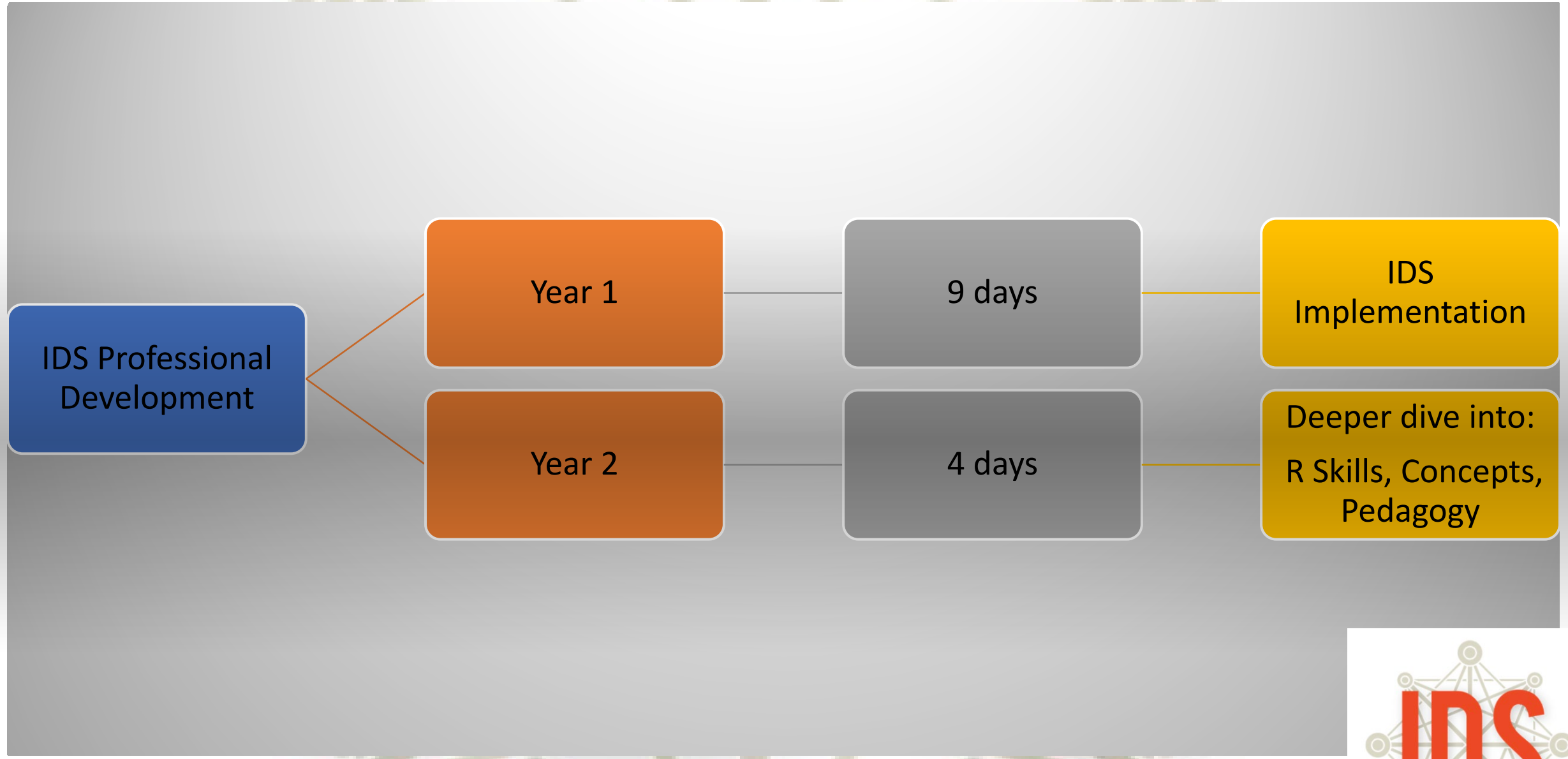
TIME USE CAMPAIGN

Professional Development

SCALE Immersion Model for Professional Learning (SIMPL™)



Source: Baxter, H., & Lauffer, D. (2007, October). The SIMPL approach to science education reform. Unpublished manuscript. Madison, WI: University of Wisconsin-Madison, Wisconsin Center for Education Research.


IDS Professional Development
Year 1
Year 2
9 days
4 days
IDS Implementation
Deeper dive into:
R Skills, Concepts, Pedagogy

WELCOME TO THE IDS TEACHERS'
COMMUNITY OF PRACTICE!

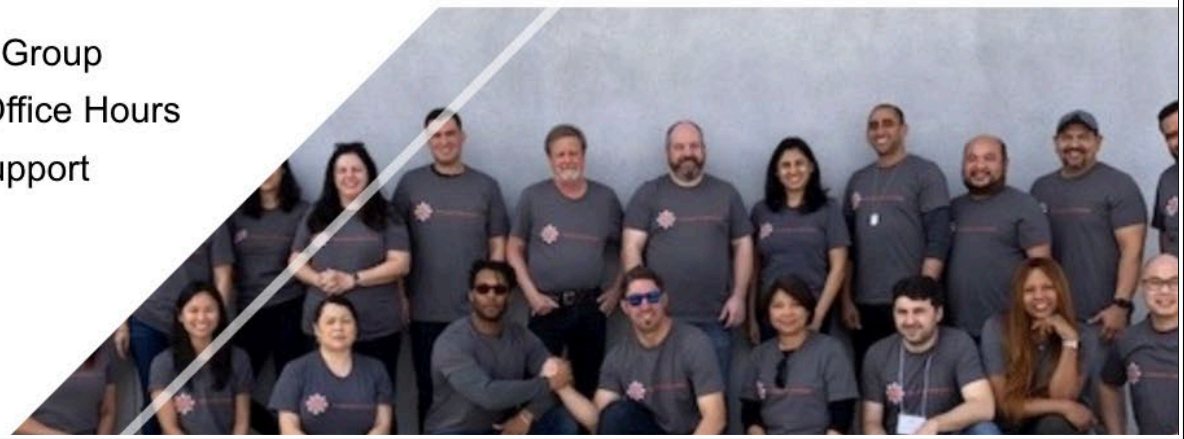
A repository for sharing resources, best practices, information,

IDS Professional Learning Community

Google Group

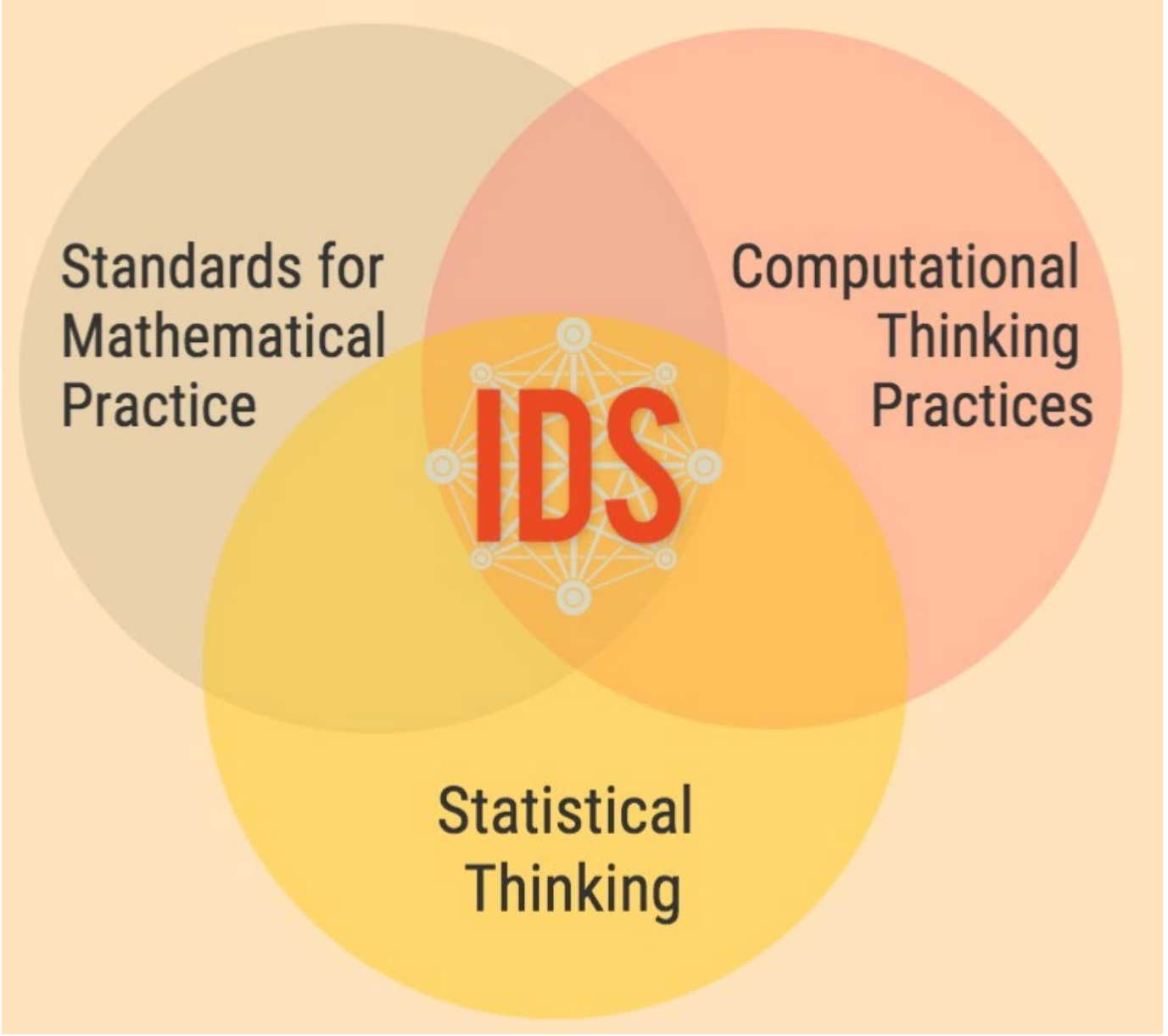
Bi-monthly Office Hours

24/7 support



Introduction to Data Science - Best Practices Video Series

By IDS Admin - 1 post - 1 view


Standards for Mathematical Practice
Computational Thinking Practices
IDS
Statistical Thinking

EMMANUEL SCHANZER

Bootstrap Data Science,
Brown University

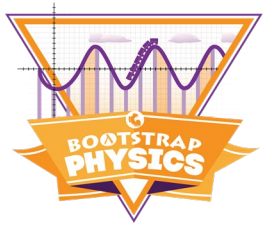
BOOTSTRAP

Equity · Scale · Rigor

We made a controversial bet...

- Siloed classes **aren't the only way** to do this
- Integrate computing & math **authentically**
- There's a way to do it equitably, **for *all* students**

15 years later....



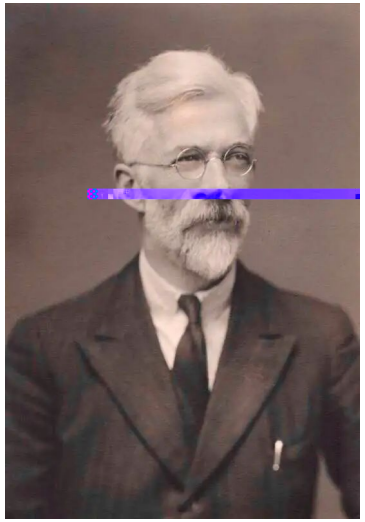
- **One of the largest providers of in-school CS nationwide**
- One of three curricula cited by the NSF
- ~43% girls and young women, ~46% black and latinx students
- Taught almost entirely by **non-CS teachers** with **no computing background**, in **non-CS classes!**

Ingredients for K-12 Data Science

Statistics

Computing

Ingredients for K-12 Data Science



```
def add5(x):
    return x+5

def dotwrite(ast):
    nodename = getNoden
    label=symbol.sym_na
    print '    %s [labe
    if isinstance(ast[1
        if ast[1].strip(
            print '= %s"]
        else:
```

Responsible K-12 Data Science

- **Computational Concepts**
  - Problem decomposition
  - Reliability
  - Reproducibility

- Bootstrap been focused on these concepts since the 1990s

- **"Coding" doesn't touch ANY of them!**

Responsible K-12 Data Science

Statistics

Computing

Civic Responsibility

Domain Investment

“New Math” 2.0

- We want to **unleash the power of data**, across the curriculum.
- We use **free tools** - a disciplined approach
  - Elementary school: *spreadsheets*
  - Middle school: *CODAP (which we have extended!)*
  - High school: Pyret
- We build **free curricular materials** for grades 5-12
- An **interdisciplinary challenge** requires an **interdisciplinary team**
- We **design for integration,** creating on-ramps for teachers in every subject, at every level - **at scale**.

Find the path that's right for *your* school or district

Access totally-free curriculum and tools

Curriculum, Training and Pedagogy designed for integration

PANEL

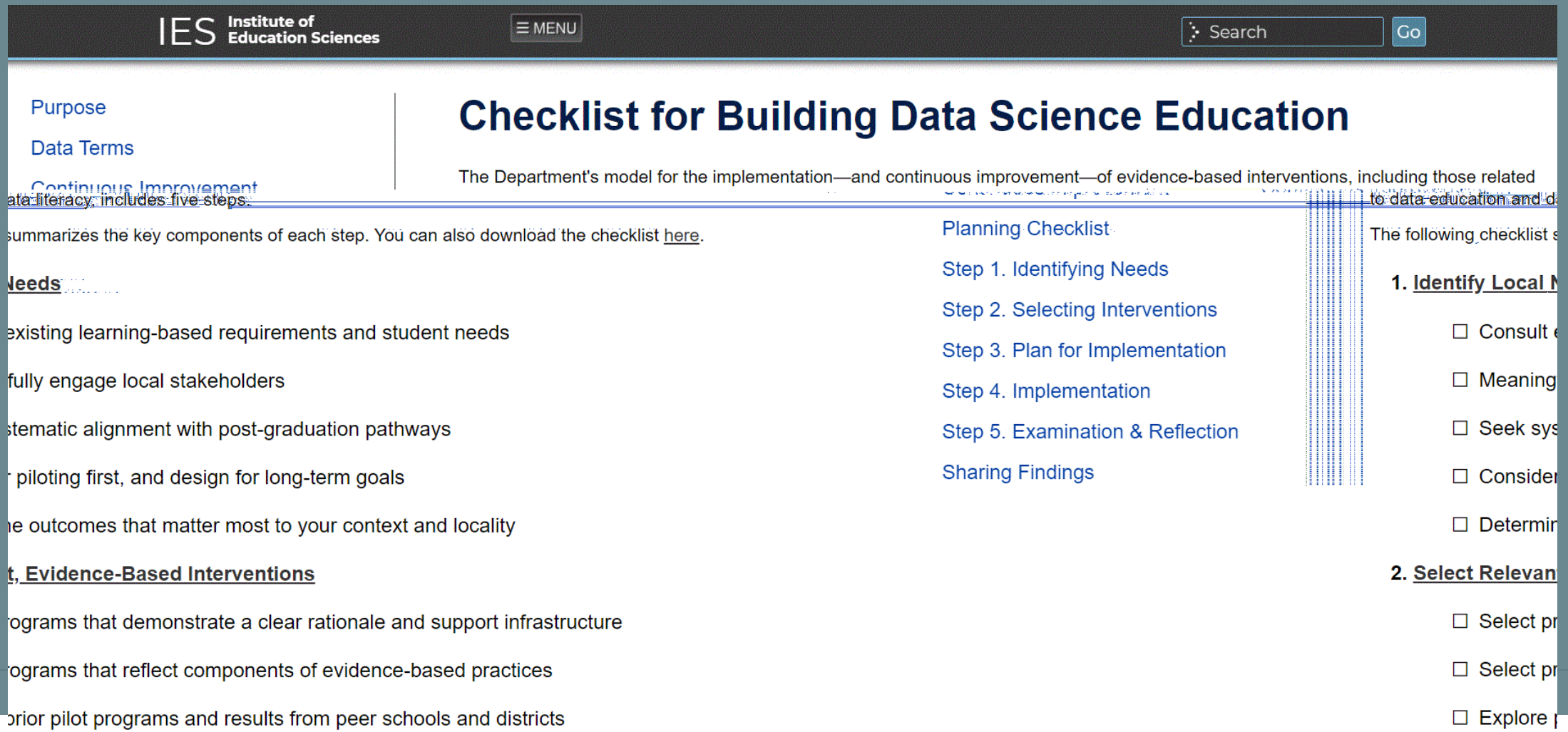
RESOURCES

- Education Materials
- Forthcoming Guidance Resources
- Federal Funding Opportunities

Education Materials & Resources

- **NASA / Microsoft "Day of Data"** – modules for using spreadsheets to explore space data in classroom settings.
- **U.S. Census Statistics in Schools Program** – lesson plans and other resources across K-12 subjects, including math, history/social studies, geography, and English
- **U.S. Census Academy** – one- or two-hour courses on using Excel, R, and Census Data. Most relevant for adult learners and teachers.
- **Data.Gov** – a centralized housing for open Federal datasets.

Forthcoming Guidance



IES Institute of Education Sciences ☰ MENU Search Go

Purpose
Data Terms
Continuous Improvement

Checklist for Building Data Science Education

The Department's model for the implementation—and continuous improvement—of evidence-based interventions, including those related

ata literacy, includes five steps.

to data education and d

summarizes the key components of each step. You can also download the checklist here.

The following checklist s

Planning Checklist
Step 1. Identifying Needs
Step 2. Selecting Interventions
Step 3. Plan for Implementation
Step 4. Implementation
Step 5. Examination & Reflection
Sharing Findings

Needs

existing learning-based requirements and student needs

fully engage local stakeholders

stematic alignment with post-graduation pathways

piloting first, and design for long-term goals

ne outcomes that matter most to your context and locality

t, Evidence-Based Interventions

rograms that demonstrate a clear rationale and support infrastructure

rograms that reflect components of evidence-based practices

rior pilot programs and results from peer schools and districts

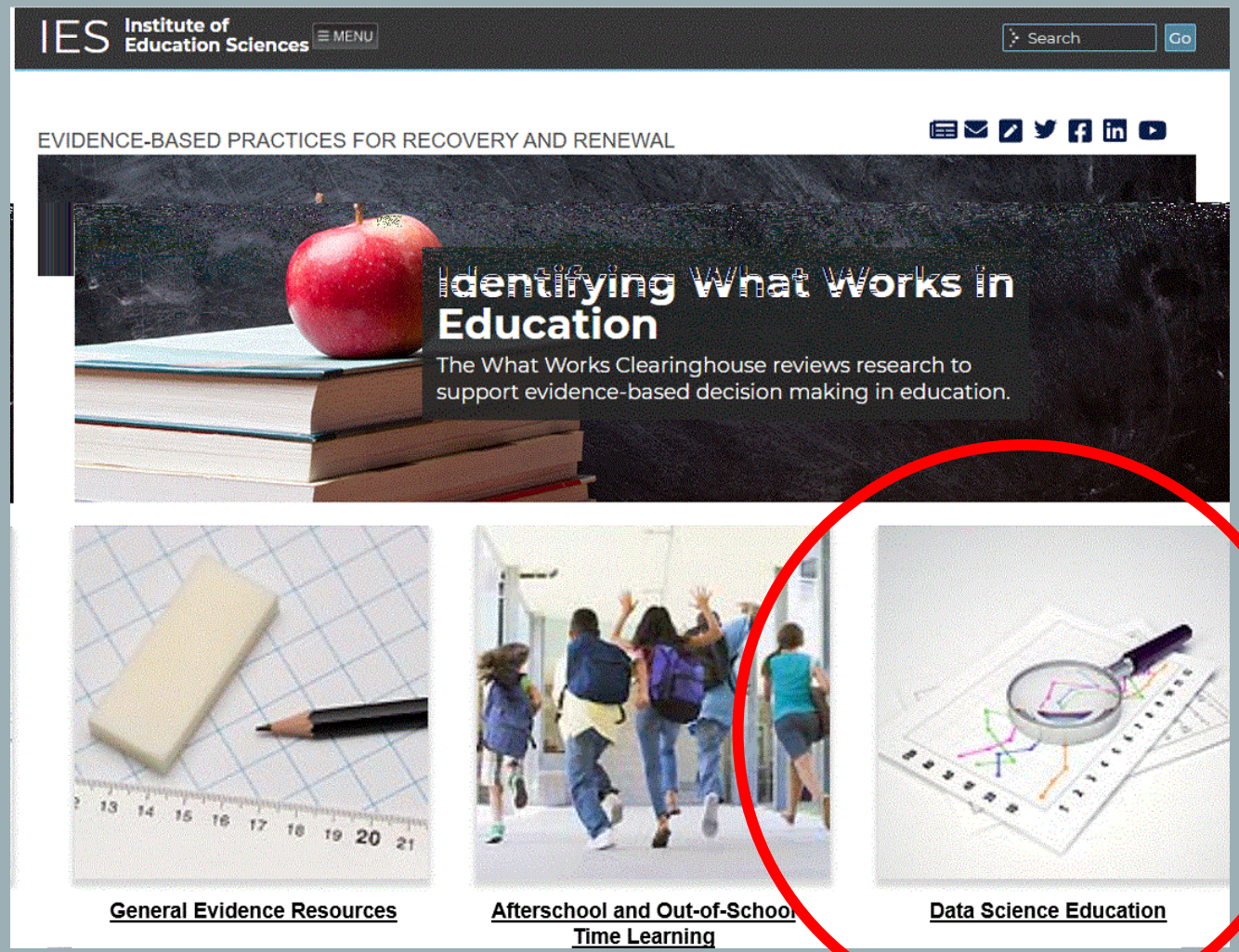
1. Identify Local N

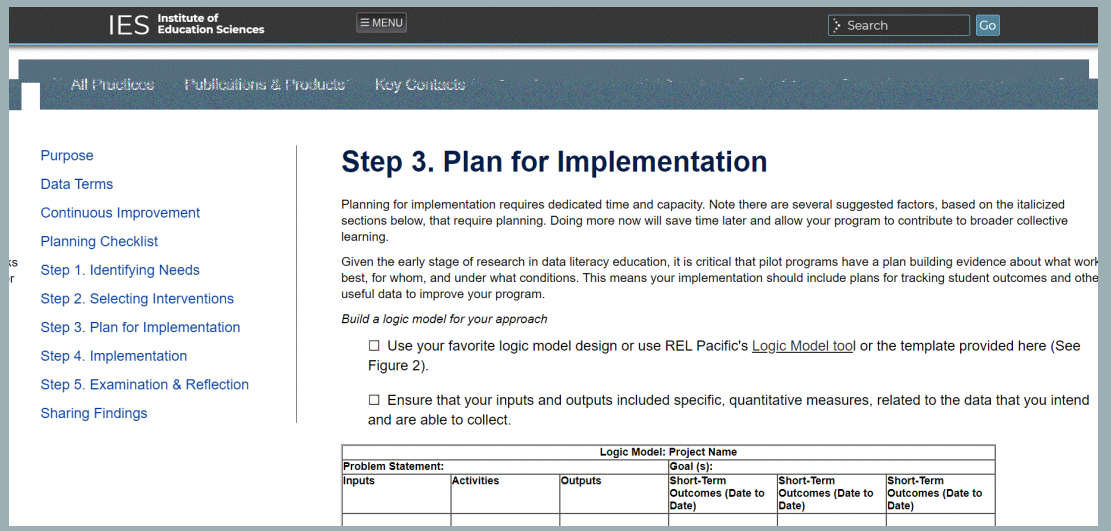
☐ Consult
☐ Meaning
☐ Seek sys
☐ Consider
☐ Determin

2. Select Relevan

☐ Select pr
☐ Select pr
☐ Explore

Soon Available on What Works Clearinghouse





Funding Resources for Supporting Data Science in K-12

- American Recovery Plan ESSER Funds (includes any ESEA activity)
- Elementary and Secondary Education Act (ESEA) Title IV Part A Funds
- Teacher Quality Partnerships (TQP)
- Supporting Effective Educator Development (SEED)
- Education Innovation Research (EIR)
- Education Research Grants (ERG)
- Federal Communications Commission E-Rate Program
- NSF Harnessing the Data Revolution (HDR) Program
- NSF Research on Learning in Formal and Informal Settings (DRL)

ARP ESSER Funds

- **Any activity authorized under ESEA is eligible.**
- Additional eligible categories include:
  - **PD**: partnerships with PD programs, hiring & retainment, technology training & literacy, and financial support, including student loans for educators (sec. D-1)
  - **Hardware**: laptops, tablets, tech accessories, and assistive technology (sec. C-19)
  - **Software**: software/online/virtual programs and online/virtual/cultural curriculum/programs (sec. C-19)
  - **Internet**: improvements in technology infrastructure, operations, and use (sec. C-19)
  - **Out of School Time**: online program, course development, hardware, or other materials (sec. C-2, C-13)
- **Must spend by 2023** – invest in long-term contracts where possible.

Regular ED Grant Programs

- **Teacher Quality Partnerships (TQP)** – funds collaborations between eligible K-12 districts and Institutes of Higher Education for teacher training
- **Supporting Effective Educator Development (SEED)** – develop, expand, and evaluate evidence-based practices for teacher training
- **Education Innovation Research (EIR) Early Phase Grants** – create, develop, implement, replicate, or take to scale field-initiated innovations
- **Education Research Grants (ERG) STEM Topic** – research on the improvement of students' STEM knowledge and skills

Other Federal Grant Programs

- **ED Office of Education Technology Grants Hub** – centralized resource of all technology-related grants and programs.
- **FCC E-Rate** – discounts for telecommunications, Internet access, and equipment to eligible schools and libraries. **See also COVID Emergency Connectivity Fund.
- **NSF Harnessing the Data Revolution** – an umbrella program covering three grant areas for graduate scholarships, data science field research, and data science institutes.
- **NSF Division of Research and Learning** – relevant programs for data science education include DRK-12, ITEST, and AISL solicitations.

SPEAKER RESOURCES

REFERENCES & RESOURCES

National Council of Teachers of Mathematics (Presenter: Trena Wilkerson| Contact: nctm@nctm.org)

Books

- Catalyzing Change Series: https://www.nctm.org/change/
- K-12 Guidelines for Assessment and Instruction in Statistics Education II (GAISE II)-Book or Free Download:
- Pre- High School Mathematics Lessons to Explore, Understand, and Respond to Social Injustice: https://www.nctm.org/Store/Products/High-School-Mathematics-Lessons-to-Explore,-Understand,-and-Respond-to-Social-Injustice/

Webinars & Web Resources

- Teacher Tip Tuesday: Avoiding Data and Science Misinformation in Today's Messy Media Landscape (Open to All): https://www.nctm.org/online-learning/Webinars/Details/527
- Recommendations for Statistics in the Secondary Curriculum: Implications for Teachers: https://www.nctm.org/online-learning/Webinars/Details/357
- The Practice of Statistics: YES, We Can Do It at School!: https://www.nctm.org/online-learning/Webinars/Details/371
- Using Math to Make Sense of Our World: Pandemics, Viruses, and Our Actions: https://www.nctm.org/online-learning/Webinars/Details/349
- Digital Classroom Resources: Search for Statistics, Data, Data Science, Data Literacy: https://www.nctm.org/classroomresources/

REFERENCES & RESOURCES

Youcubed Data Science (Presenter: Jo Boaler | Contact: contact@bootstrapworld.org)

- Website: https://www.youcubed.org/
- Teacher Online Course: https://www.youcubed.org/21st-century-teaching-and-learning/
- High School Data Science Course: https://www.youcubed.org/resource/high-school-data-science-course/
- Data Science K-12 Lesson Plans: https://www.youcubed.org/data-science-lessons/
- Data Talks: https://www.youcubed.org/data-science-lessons/
- Data Big Ideas (K-10): https://www.youcubed.org/data-big-ideas/

Introduction to Data Science (Presenter: Suyen Machado | Contact: info@idsucla.org**)**

- Website: https://www.introdatascience.org
- Program Overview: https://www.introdatascience.org/introduction-to-data-science-curriculum
- Partnering with IDS: https://www.introdatascience.org/introduction-to-data-science-partnership
- Research & Publications: https://www.introdatascience.org/news-publications-and-presentations

REFERENCES & RESOURCES

Bootstrap Data Science (Presenter: Emmanuel Schanzer | Contact: contact@bootstrapworld.org)

- Website: https://www.BootstrapWorld.org
- DS materials: https://www.bootstrapworld.org/materials/data-science/
  (Elementary grade materials are available upon *request*, but not yet linked publicly)
- Published research: www.BootstrapWorld.org/impact
- Work on accessibility:
  https://cs.brown.edu/~sk/Publications/Papers/Published/sbk-adap-stud-ide-blind-prog/
  https://cs.brown.edu/~sk/Publications/Papers/Published/sbk-accessible-ast-blocks/
- "4 ingredients of K12 Data Science" position paper:
  https://bootstrapworld.org/blog/curriculum/Four-Ingredients-of-Data-Science-Education.shtml
- A sneak peak at our upcoming paper on the role of Domain Investment in K12 Data Science
  https://bootstrapworld.org/blog/curriculum/Data-Science-Student-Experience.shtml

REFERENCES & RESOURCES

Federal Funding Resources (Presenter: Zarek Drozda | Contact: zarek.drozda@ed.gov)

- ARP ESSER Funds FAQ Guidance (May 2021): https://oese.ed.gov/files/2021/05/ESSER.GEER_.FAQs_5.26.21_745AM_FINALb0cd6833f6f46e03ba2d97d30aff953260028045f9ef3b18ea602db4b32b1d99.pdf
- Teacher Quality Partnerships (TQP): https://oese.ed.gov/offices/office-of-discretionary-grants-support-services/effective-educator-development-programs/teacher-quality-partnership/about-us/
- Supporting Effective Educator Development (SEED): https://oese.ed.gov/offices/office-of-discretionary-grants-support-services/effective-educator-development-programs/supporting-effective-educator-development-grant-program/us-supporting-effective-educator-development/
- Education Innovation Research (EIR): https://oese.ed.gov/offices/office-of-discretionary-grants-support-services/innovation-early-learning/education-innovation-and-research-eir/
- Education Research Grant Program (ERG): https://ies.ed.gov/funding/ncer_progs.asp
- OET Education Technology Grants Hub: https://tech.ed.gov/funding/
- FCC E-Rate: https://www.usac.org/e-rate/
- FCC Emergency Connectivity Fund: https://www.fcc.gov/emergency-connectivity-fund-faqs
- NSF Harnessing the Data Revolution: https://www.nsf.gov/cise/harnessingdata/
- NSF Division of Research and Learning: https://www.nsf.gov/div/index.jsp?div=DRL

QUESTIONS FOR ED?

Zarek Drozda | Data Science Education Fellow
Zarek.Drozda@ed.gov

Patti Curtis | Robert Noyce/Ellen Lettvin STEM Education Fellow
Patti.Curtis@ed.gov

Melissa Moritz | Afterschool and Summer Learning Fellow
Melissa.W.Moritz@ed.gov